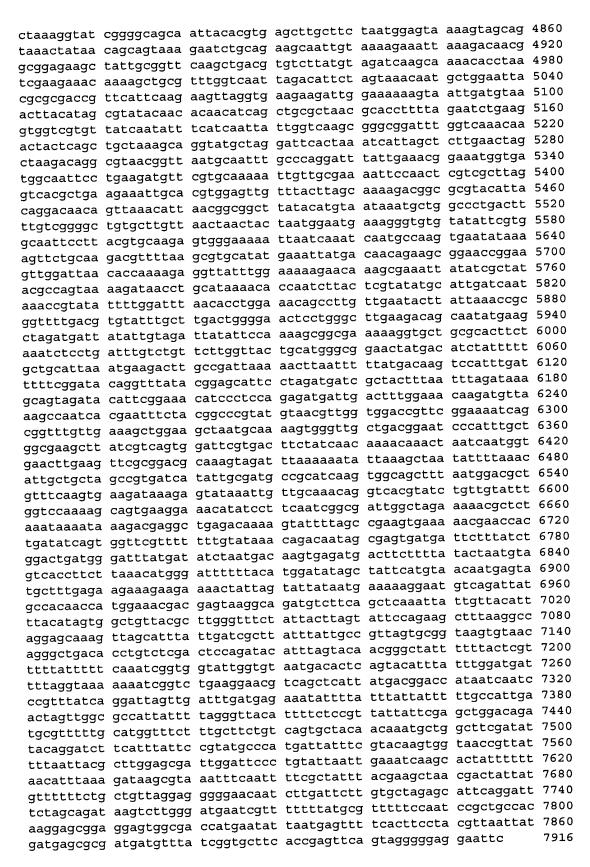SEQUENCE LISTING

<110> McCool, Gabriel J.
      Cannon, Maura C.
      Cannon, Francis C.
      Valentin, Henry E.
      Gruys, Kenneth J.


<120> POLYHYDROXYALKANOATE BIOSYNTHESIS ASSOCIATED PROTEINS
      AND CODING REGION IN  BACILLUS MEGATERIUM


<130> MOBT212


<140> 60/115,092
<141> 1999-01-07


<160> 29


<170> PatentIn Ver. 2.1


<210> 1
<211> 7916
<212> DNA
<213> Bacillus megaterium


<400> 1
aagcttaaca aaaggttaga gggcttttaa ttgacttatt aatgaacctt ttataaaata 60
aaaacaactt aatacattta cttcttacgg agtaaagggg agtagcgtca gggaaacctg 120
aaacaaagtc gtcattacat ggagtattcc atcggctttg ttggcataat gattatgctt 180
agcaagacct ttgccatatt tggcaaaggt ctttttgtgt tttattccgg taatgaggat 240
aaataaactt atacaaagaa acgagagggg attttatgg atgcatcact tttgttagag 300
tatggatggg tattgctagt gctggttgca ttagaaggaa ttttggcggc ggataatgct 360
cttgtgatgg ctattatggt caaacattta ccggaagaaa acgcaagaa ggcattattt 420
tacggattag ccggtgcctt tattttaga tttggttcgt tgttcttgat ttcattttta 480
gtcgacgtat ggcagcttca agctatagga gccatttact tattgttcat ttccattaat 540
catattgtga agcgatatgt gaaaaaagac gatcatgaaa aagtgaaaga agcagacgag 600
aaaaagggct caggtttctg gatgacggtt ttaaaagtag aaatagcaga cattgctttt 660
gccgttgatt caattttggc cgctgtggct ctcgccgtta cgttgccaac aacaaatctt 720
cctcaaattg gcggactcga cggcggacaa ttcttggtga tcttcgccgg aggaattatg 780
ggattaatta ttatgcgttt tgctgcaact tggttcgtca agctattaaa tacgcgccca 840
ggcctagaaa cggcggcttt tgctattgta ggctgggtag gagttaagtt agcggtctat 900
acccttgctc atccagagtt aggtattatt aatgaacatt tccctgaatc aaaagtgtgg 960
aaaattacgt tttggattgt gttacttggc atagctgctt caggctggtt tctatctaaa 1020
aataaagaac aaactgatct tgaaggctca gagaagaaa aagaatcgtt aaaaaaaatt 1080
gaaaatcaat aataaaaaaa acgcgccttc aatgttaatt gaaggcgcgt tttttatagg 1140
gggataaaat acctagttta gattgtttaa ataaagggta aagaattaa ttactgttta 1200
attactgtat atccgaatgt tttgcttttt cgttcatatt ctgtagagaa cagagccgtg 1260
agtaattcag ttcaatgaag tttatttcag tttataaaca tatatttcaa atgtatgtta 1320
attggtaaaa ttgagctatt atgggttata ataaggaaa attaaaagga gcagagcgct 1380
tctcaacccct gttcgtcatc aaaagaatgg atattaacat ggtataaagc aactgagtat 1440
agtaaaagag gtgaagccaa tgctcacaaa agttcaaacg cctccatcgc ttgaaacgct 1500
tgtactgacg attcagcaag gggataaaca attacataat gaaatgattc aacaatataa 1560
accgtttatt gctaaagttg tttcagctgt atgtaaacgt tatataagtg aagctgacga 1620

-96 of 112-

```
tgaatttagc attggtctga ttgcatttaa tgaagccatt gaaaattaca caatccaaaa 1680
aggacgatct cttcttgcat ttgcggaact tattattaaa agaagagtaa tcgactatat 1740
tcgaaaagaa aagcgaaatc aaacgctgct ctataaccga attgaaaatg aaggttttat 1800
tcaaggtaag gtagaaaggg atatatcgct ttctaactat aaaaggcaaa gtgaaacttc 1860
atatattcaa gaggaaatga cttatttttg tcaggcgcta aaattgttta aattaactct 1920
tgaagacatt attaacacgt ctcctaaaca taaggatgca aggggaaatg cagtggaagt 1980
tgcatctttt atcgtcaatg aaaaagaatt aaaagataag ctgtttttaa agcggcagct 2040
tcctattcgc ttgattgaaa aacatgtcaa agtaagccgg aaaacaattg aaagaaaccg 2100
taaatatatt atcgcgatgg ttattatatt agcgggggac tacgtgtatt taaaagacta 2160
tattatgtaa gaaaaaggca cacgcaggtg cctttttta gccatgttat gaaattatgt 2220
tttatttttg tgtgctgccg cttaagtgag cttgagcttg ttgcaccaag cgttttgtga 2280
tttctccgcc tactgaaccg ttgctgcgtg cagcagtgtc agaacctaga gttaccccaa 2340
attcttgagc gatttcatat ttatattgat ctaaaaattg ttctactcct ggtgttaata 2400
gtttatttgt tctagccatg attagtcatc tccttttta gtggtacagc agttcactgc 2460
tgtacctgta ttatttgttg tttcctattt tgcatactgg taatggtttg caagaaagta 2520
taaaaaagcc cagctttcaa agaagctggg ctttttata tattatttta caactgcata 2580
ttgctcaaga gactgagcaa atgactttg aagagatttt acttgttcta cgtatgcatc 2640
agatacgtgt tggaattctt ggcgcgtttt cttttgctct tctactaatt gtgttactac 2700
ttgatgatat tgttcttgcg cttgctttac taaagaatag cttgatttgc tttggttaaa 2760
aaaaagctct tgtaatttat ttaatgcttc atgcgtgcgg tttgtccatt cttcataaga 2820
atcggcaaca gcgtttccag ctgtttacg taagttttca actgtttttt gttgaaggtc 2880
ttccaattca gctttccatt gtttgtctgt tgcttgaagt tgttcaactg cttttgttac 2940
aaattcttgc tgttgctcaa gtgctttaa cgtccattgc tcaatttgtt tgtttccgtc 3000
tgcaatgttt tgtaacccct ttgtccattg ttcccacatt gcatcaatta ctgtatcata 3060
ctttactgtt gacataatca aattcctcct tgaataattt ggtctggcga acagttatcg 3120
taatgaacaa aacgttaaag aagaaattcg tagttgtgtg ataaacctaa cattccgcgc 3180
tcgctggttg accgtgaaat ttaacattat attaggaaac gcagatgtac tgcgtgaatc 3240
cctttaatcg ttttcttcct cttttgattc ttttgacttt ttagaagaag aagagctaaa 3300
agggaacaac atgtcggtat acatgtgaaa aaatgaatct aacatgtttt gatactgttc 3360
aagtgaatta gcccacatac ttaaatattg ttcgccggca tctgttaatg aataaatccg 3420
gcgtgcaggt ccttcagctg acgtatccca ttgcgatgta atcaagttgt ctttttcaag 3480
ctgtctcagc gtgcggtaga catttccctg atcaactgat gtgaatccaa agctcattag 3540
ttgctgaatg agcttgtaac catgtagatt ccaccctctt aaacttaaaa gaagaaaagg 3600
aaccatcaag ttttttggtg caccgctaat cgattttct aagttgtttg aattagaggt 3660
gttatctttt tcacttgatc ccaaggtaat caccccttcg aaaaaagaga atttgttttc 3720
catatgtgta atttacacct agatgaaaaa attgtcaaca ctttaaaaca ggtctttcaa 3780
atacaggaaa aaagaacgat tttttggatt tcgacaaaaa gcgtcaaaaa aattcaaaaa 3840
taaacaaaga tttagaattg tttattttgg aaaacgtatt tataatagta catgtaggta 3900
attttataa catttataat ttgttggtaa gtgaattgtg aaaagattta cattatccaa 3960
taaataaacg caaaattggt tgcgtttact tagagcttct aatatgtcgc ttgtcacatt 4020
aagtgtccat attgaaagcc atcacttta acgtacacaa gaaaggagat ggagttttgg 4080
aacagcaaaa agtatttgat ccgtttcaag catggaaaga cgtatatgac aaaaccgaat 4140
cttactgggg taaagttatt ggggacaata tgaatcgtga agaattttcc cagctcatgg 4200
gaaatgtgct aaatatgaac cttcaatatc aacaagcagt aaatgaagta acggggcgct 4260
atctgcacca agtaaatgta ccaacaaaag aagatgtagc aaacgttgcg tcattagtca 4320
tcaatgtgga agaaaaagta gaattattag aagagcaatt tgacgatcgt tttgatgaat 4380
tagaagcaca gcaagaaagt gcatctgctt tgaaaaaaga tgtcactaag ctgaaatctg 4440
atgtcaaatc gttagacaaa aaactcgata agtttttatc tcttcttgaa gggcagcaaa 4500
aaacacaaga cgagttaaaa gaaacgattc aaaaacaaat taaaactcaa ggtgagcagc 4560
ttcaggctca gctgttagaa aaacaagaaa aattagctga aaagccaaag gcagaagcta 4620
aatctgaagc aaaaccatca aacgctcaaa aaactgagca gccggctcgc aagtaaggta 4680
tcggagattt tataacaaca ttaactgctg tatttacagt aaaaatcatc gctgaagaag 4740
caaggggaa atttttcatg acaacattac aaggtaaagt agcaatcgta acaggcggat 4800
```

Cannon Application

```
ctaaaggtat cggggcagca attacacgtg agcttgcttc taatggagta aaagtagcag 4860
taaactataa cagcagtaaa gaatctgcag aagcaattgt aaaagaaatt aaagacaacg 4920
gcggagaagc tattgcggtt caagctgacg tgtcttatgt agatcaagca aaacacctaa 4980
tcgaagaaac aaaagctgcg tttggtcaat tagacattct agtaaacaat gctggaatta 5040
cgcgcgaccg ttcattcaag aagttaggtg aagaagattg gaaaaaagta attgatgtaa 5100
acttacatag cgtatacaac acaacatcag ctgcgctaac gcaccttta gaatctgaag 5160
gtggtcgtgt tatcaatatt tcatcaatta ttggtcaagc gggcggattt ggtcaaacaa 5220
actactcagc tgctaaagca ggtatgctag gattcactaa atcattagct cttgaactag 5280
ctaagacagg cgtaacggtt aatgcaattt gcccaggatt tattgaaacg gaaatggtga 5340
tggcaattcc tgaagatgtt cgtgcaaaaa ttgttgcgaa aattccaact cgtcgcttag 5400
gtcacgctga agaaattgca cgtggagttg tttacttagc aaaagacggc gcgtacatta 5460
caggacaaca gttaaacatt aacggcggct tatacatgta ataaatgctg gccctgactt 5520
ttgtcggggc tgtgcttgtt aactaactac taatggaatg aaagggtgtg tatattcgtg 5580
gcaattcctt acgtgcaaga gtgggaaaaa ttaatcaaat caatgccaag tgaatataaa 5640
agttctgcaa gacgttttaa gcgtgcatat gaaattatga caacagaagc ggaaccggaa 5700
gttggattaa caccaaaaga ggttatttgg aaaaagaaca aagcgaaatt atatcgctat 5760
acgccagtaa aagataacct gcataaaaca ccaatcttac tcgtatatgc attgatcaat 5820
aaaccgtata tttttggattt aacacctgga aacagccttg ttgaatactt attaaaccgc 5880
ggttttgacg tgtatttgct tgactgggga actcctgggc ttgaagacag caatatgaag 5940
ctagatgatt atattgtaga ttatattcca aaagcggcga aaaaggtgct gcgcacttct 6000
aaatctcctg atttgtctgt tcttggttac tgcatgggcg gaactatgac atctattttt 6060
gctgcattaa atgaagactt gccgattaaa aacttaattt ttatgacaag tccatttgat 6120
ttttcggata caggtttata cggagcattc ctagatgatc gctactttaa tttagataaa 6180
gcagtagata cattcggaaa catccctcca gagatgattg actttggaaa caagatgtta 6240
aagccaatca cgaatttcta cggcccgtat gtaacgttgg tggaccgttc ggaaaatcag 6300
cggtttgttg aaagctggaa gctaatgcaa aagtgggttg ctgacggaat cccatttgct 6360
ggcgaagctt atcgtcagtg gattcgtgac ttctatcaac aaaacaaact aatcaatggt 6420
gaacttgaag ttcgcggacg caaagtagat ttaaaaaata ttaaagctaa tatttttaaac 6480
attgctgcta gccgtgatca tattgcgatg ccgcatcaag tggcagcttt aatggacgct 6540
gtttcaagtg aagataaaga gtataaattg ttgcaaacag gtcacgtatc tgttgtattt 6600
ggtccaaaag cagtgaagga aacatatcct tcaatcggcg attggctaga aaaacgctct 6660
aaataaaata aagacgaggc tgagacaaaa gtattttagc cgaagtgaaa aacgaaccac 6720
tgatatcagt ggttcgtttt tttgtataaa cagacaatag cgagtgatga ttctttatct 6780
ggactgatgg gatttatgat atctaatgac aagtgagatg acttctttta tactaatgta 6840
gtcaccttct taaacatggg attttttaca tggatatagc tattcatgta acaatgagta 6900
tgctttgaga agaagaaga aaactattag tattataatg aaaaaggaat gtcagattat 6960
gccacaacca tggaaacgac gagtaaggca gatgtcttca gctcaaatta ttgttacatt 7020
ttacatagtg gctgttacgc ttgggtttct attacttagt attccagaag cttaaggcc 7080
aggagcaaag ttagcatta ttgatcgctt atttattgcc gttagtgcgg taagtgtaac 7140
agggctgaca cctgtctcga ctccagatac atttagtaca acgggctatt ttttactcgt 7200
ttttattttt caaatcggtg gtattggtgt aatgacactc agtacattta tttggatgat 7260
tttaggtaaa aaaatcggtc tgaaggaacg tcagctcatt atgacggacc ataatcaatc 7320
ccgtttatca ggattagttg atttgatgag aaatatttta tttattattt ttgccattga 7380
actagttggc gccattattt tagggttaca ttttctccgt tattattcga gctggacaga 7440
tgcgttttg catggtttct ttgcttctgt cagtgctaca acaaatgctg gcttcgatat 7500
tacaggatct tcatttattc cgtatgccca tgattatttc gtacaagtgg taaccgttat 7560
tttaattacg cttggagcga ttggattccc tgtattaatt gaaatcaagc actatttttt 7620
aacatttaaa gataagcgta aatttcaatt ttcgctattt acgaagctaa cgactattat 7680
gttttttctg ctgttaggag ggggaacaat cttgattctt gtgctagagc attcaggatt 7740
tctagcagat aagtcttggg atgaatcgtt tttttatgcg tttttccaat ccgctgccac 7800
aaggagcgga ggagtggcga ccatgaatat taatgagttt tcacttccta cgttaattat 7860
gatgagcgcg atgatgttta tcggtgcttc accgagttca gtaggggggag gaattc      7916
```

-98 of 112-

<210> 2
<211> 510
<212> DNA
<213> Bacillus megaterium

<400> 2
atgtcaacag taaagtatga tacagtaatt gatgcaatgt gggaacaatg gacaaagggg 60
ttacaaaaca ttgcagacgg aaacaaacaa attgagcaat ggacgttaaa agcacttgag 120
caacagcaag aatttgtaac aaaagcagtt gaacaacttc aagcaacaga caaacaatgg 180
aaagctgaat tggaagacct tcaacaaaaa acagttgaaa acttacgtaa aacagctgga 240
aacgctgttg ccgattctta tgaagaatgg acaaaccgca cgcatgaagc attaaataaa 300
ttacaagagc ttttttttaa ccaaagcaaa tcaagctatt ctttagtaaa gcaagcgcaa 360
gaacaatatc atcaagtagt aacacaatta gtagaagagc aaaagaaaac gcgccaagaa 420
ttccaacacg tatctgatgc atacgtagaa caagtaaaat ctcttcaaaa gtcatttgct 480
cagtctcttg agcaatatgc agttgtaaaa 510


<210> 3
<211> 170
<212> PRT
<213> Bacillus megaterium

<400> 3
Met Ser Thr Val Lys Tyr Asp Thr Val Ile Asp Ala Met Trp Glu Gln
1               5                   10                  15

Trp Thr Lys Gly Leu Gln Asn Ile Ala Asp Gly Asn Lys Gln Ile Glu
                20                  25                  30

Gln Trp Thr Leu Lys Ala Leu Glu Gln Gln Gln Glu Phe Val Thr Lys
            35                  40                  45

Ala Val Glu Gln Leu Gln Ala Thr Asp Lys Gln Trp Lys Ala Glu Leu
        50                  55                  60

Glu Asp Leu Gln Gln Lys Thr Val Glu Asn Leu Arg Lys Thr Ala Gly
65                  70                  75                  80

Asn Ala Val Ala Asp Ser Tyr Glu Glu Trp Thr Asn Arg Thr His Glu
                85                  90                  95

Ala Leu Asn Lys Leu Gln Glu Leu Phe Phe Asn Gln Ser Lys Ser Ser
                100                 105                 110

Tyr Ser Leu Val Lys Gln Ala Gln Glu Gln Tyr His Gln Val Val Thr
            115                 120                 125

Gln Leu Val Glu Glu Gln Lys Lys Thr Arg Gln Glu Phe Gln His Val
        130                 135                 140

Ser Asp Ala Tyr Val Glu Gln Val Lys Ser Leu Gln Lys Ser Phe Ala
145                 150                 155                 160

```
Gln Ser Leu Glu Gln Tyr Ala Val Val Lys
            165                     170


<210> 4
<211> 438
<212> DNA
<213> Bacillus megaterium

<400> 4
ttgggatcaa gtgaaaaaga taacacctct aattcaaaca acttagaaaa atcgattagc 60
ggtgcaccaa aaaacttgat ggttcctttt cttcttttaa gtttaagagg gtggaatcta 120
catggttaca agctcattca gcaactaatg agctttggat tcacatcagt tgatcaggga 180
aatgtctacc gcacgctgag acagcttgaa aaagacaact tgattacatc gcaatgggat 240
acgtcagctg aaggacctgc acgccggatt tattcattaa cagatgccgg cgaacaatat 300
ttaagtatgt gggctaattc acttgaacag tatcaaaaca tgttagattc attttttcac 360
atgtataccg acatgttgtt cccttttagc tcttcttctt ctaaaaagtc aaaagaatca 420
aaagaggaag aaaacgat                                              438


<210> 5
<211> 146
<212> PRT
<213> Bacillus megaterium

<400> 5
Met Gly Ser Ser Glu Lys Asp Asn Thr Ser Asn Ser Asn Asn Leu Glu
  1               5                  10                  15

Lys Ser Ile Ser Gly Ala Pro Lys Asn Leu Met Val Pro Phe Leu Leu
             20                  25                  30

Leu Ser Leu Arg Gly Trp Asn Leu His Gly Tyr Lys Leu Ile Gln Gln
         35                  40                  45

Leu Met Ser Phe Gly Phe Thr Ser Val Asp Gln Gly Asn Val Tyr Arg
     50                  55                  60

Thr Leu Arg Gln Leu Glu Lys Asp Asn Leu Ile Thr Ser Gln Trp Asp
 65                  70                  75                  80

Thr Ser Ala Glu Gly Pro Ala Arg Arg Ile Tyr Ser Leu Thr Asp Ala
                 85                  90                  95

Gly Glu Gln Tyr Leu Ser Met Trp Ala Asn Ser Leu Glu Gln Tyr Gln
            100                 105                 110

Asn Met Leu Asp Ser Phe Phe His Met Tyr Thr Asp Met Leu Phe Pro
            115                 120                 125

Phe Ser Ser Ser Ser Ser Lys Lys Ser Lys Glu Ser Lys Glu Glu Glu
            130                 135                 140
```

H: 365662(7%5@01!.DOC)

Asn Asp
145


<210> 6
<211> 504
<212> DNA
<213> Bacillus megaterium

<400> 6
atgaatcgtg aagaattttc ccagctcatg ggaaatgtgc taaatatgaa ccttcaatat 60
caacaagcag taaatgaagt aacggggcgc tatctgcacc aagtaaatgt accaacaaaa 120
gaagatgtag caaacgttgc gtcattagtc atcaatgtgg aagaaaaagt agaattatta 180
gaagagcaat ttgacgatcg ttttgatgaa ttagaagcac agcaagaaag tgcatctgct 240
ttgaaaaaag atgtcactaa gctgaaatct gatgtcaaat cgttagacaa aaaactcgat 300
aaagttttat ctcttcttga agggcagcaa aaaacacaag acgagttaaa agaaacgatt 360
caaaaacaaa ttaaaactca aggtgagcag cttcaggctc agctgttaga aaaacaagaa 420
aaattagctg aaaagccaaa ggcagaagct aaatctgaag caaaaccatc aaacgctcaa 480
aaaactgagc agccggctcg caag 504


<210> 7
<211> 168
<212> PRT
<213> Bacillus megaterium

<400> 7
Met Asn Arg Glu Glu Phe Ser Gln Leu Met Gly Asn Val Leu Asn Met
 1               5                  10                  15

Asn Leu Gln Tyr Gln Gln Ala Val Asn Glu Val Thr Gly Arg Tyr Leu
            20                  25                  30

His Gln Val Asn Val Pro Thr Lys Glu Asp Val Ala Asn Val Ala Ser
        35                  40                  45

Leu Val Ile Asn Val Glu Glu Lys Val Glu Leu Leu Glu Glu Gln Phe
    50                  55                  60

Asp Asp Arg Phe Asp Glu Leu Glu Ala Gln Gln Glu Ser Ala Ser Ala
65                  70                  75                  80

Leu Lys Lys Asp Val Thr Lys Leu Lys Ser Asp Val Lys Ser Leu Asp
                85                  90                  95

Lys Lys Leu Asp Lys Val Leu Ser Leu Leu Glu Gly Gln Gln Lys Thr
            100                 105                 110

Gln Asp Glu Leu Lys Glu Thr Ile Gln Lys Gln Ile Lys Thr Gln Gly
        115                 120                 125

Glu Gln Leu Gln Ala Gln Leu Leu Glu Lys Gln Glu Lys Leu Ala Glu

```
Lys Pro Lys Ala Glu Ala Lys Ser Glu Ala Lys Pro Ser Asn Ala Gln
145               150            155               160


Lys Thr Glu Gln Pro Ala Arg Lys
                165
```

<210> 8
<211> 741
<212> DNA
<213> Bacillus megaterium

<400> 8

```
atgacaacat tacaaggtaa agtagcaatc gtaacaggcg gatctaaagg tatcggggca 60
gcaattacac gtgagcttgc ttctaatgga gtaaaagtag cagtaaacta taacagcagt 120
aaagaatctg cagaagcaat tgtaaaagaa attaaagaca acggcggaga agctattgcg 180
gttcaagctg acgtgtctta tgtagatcaa gcaaaacacc taatcgaaga aacaaaagct 240
gcgtttggtc aattagacat tctagtaaac aatgctggaa ttacgcgcga ccgttcattc 300
aagaagttag gtgaagaaga ttggaaaaaa gtaattgatg taaacttaca tagcgtatac 360
aacacaacat cagctgcgct aacgcacctt ttagaatctg aaggtggtcg tgttatcaat 420
atttcatcaa ttattggtca agcgggcgga tttggtcaaa caaactactc agctgctaaa 480
gcaggtatgc taggattcac taaatcatta gctcttgaac tagctaagac aggcgtaacg 540
gttaatgcaa tttgcccagg atttattgaa acggaaatgg tgatggcaat tcctgaagat 600
gttcgtgcaa aaattgttgc gaaaattcca actcgtcgct taggtcacgc tgaagaaatt 660
gcacgtggag ttgtttactt agcaaaagac ggcgcgtaca ttacaggaca acagttaaac 720
attaacggcg gcttatacat g                                         741
```

<210> 9
<211> 247
<212> PRT
<213> Bacillus megaterium

<400> 9

```
Met Thr Thr Leu Gln Gly Lys Val Ala Ile Val Thr Gly Gly Ser Lys
1                5                  10                  15


Gly Ile Gly Ala Ala Ile Thr Arg Glu Leu Ala Ser Asn Gly Val Lys
                20                25                  30


Val Ala Val Asn Tyr Asn Ser Ser Lys Glu Ser Ala Glu Ala Ile Val
            35                40                  45


Lys Glu Ile Lys Asp Asn Gly Gly Glu Ala Ile Ala Val Gln Ala Asp
    50                55                  60


Val Ser Tyr Val Asp Gln Ala Lys His Leu Ile Glu Glu Thr Lys Ala
65                70                  75                  80


Ala Phe Gly Gln Leu Asp Ile Leu Val Asn Asn Ala Gly Ile Thr Arg
                85                90                  95
```

-102 of 112-

Asp Arg Ser Phe Lys Lys Leu Gly Glu Glu Asp Trp Lys Lys Val Ile
        100                 105                 110

Asp Val Asn Leu His Ser Val Tyr Asn Thr Thr Ser Ala Ala Leu Thr
        115                 120                 125

His Leu Leu Glu Ser Glu Gly Gly Arg Val Ile Asn Ile Ser Ser Ile
        130                 135                 140

Ile Gly Gln Ala Gly Gly Phe Gly Gln Thr Asn Tyr Ser Ala Ala Lys
145                 150                 155                 160

Ala Gly Met Leu Gly Phe Thr Lys Ser Leu Ala Leu Glu Leu Ala Lys
                165         .   .       170                 175

Thr Gly Val Thr Val Asn Ala Ile Cys Pro Gly Phe Ile Glu Thr Glu
                180                 185                 190

Met Val Met Ala Ile Pro Glu Asp Val Arg Ala Lys Ile Val Ala Lys
                195                 200                 205

Ile Pro Thr Arg Arg Leu Gly His Ala Glu Glu Ile Ala Arg Gly Val
        210                 215                 220

Val Tyr Leu Ala Lys Asp Gly Ala Tyr Ile Thr Gly Gln Gln Leu Asn
225                 230                 235                 240

Ile Asn Gly Gly Leu Tyr Met
                245


<210> 10
<211> 1086
<212> DNA
<213> Bacillus megaterium

<400> 10
gtggcaattc cttacgtgca agagtgggaa aaattaatca aatcaatgcc aagtgaatat 60
aaaagttctg caagacgttt taagcgtgca tatgaaatta tgacaacaga agcggaaccg 120
gaagttggat taacaccaaa agaggttatt tggaaaaaga acaaagcgaa attatatcgc 180
tatacgccag taaaagataa cctgcataaa acaccaatct tactcgtata tgcattgatc 240
aataaaccgt atattttgga tttaacacct ggaaacagcc ttgttgaata cttattaaac 300
cgcggttttg acgtgtattt gcttgactgg ggaactcctg ggcttgaaga cagcaatatg 360
aagctagatg attatattgt agattatatt ccaaaagcgg cgaaaaaggt gctgcgcact 420
tctaaatctc ctgatttgtc tgttcttggt tactgcatgg gcggaactat gacatctatt 480
tttgctgcat taaatgaaga cttgccgatt aaaaacttaa tttttatgac aagtccattt 540
gattttttcgg atacaggttt atacggagca ttcctagatg atcgctactt taatttagat 600
aaagcagtag atacattcgg aaacatccct ccagagatga ttgactttgg aaacaagatg 660
ttaaagccaa tcacgaattt ctacggcccg tatgtaacgt tggtggaccg ttcggaaaat 720
cagcggtttg ttgaaagctg gaagctaatg caaaagtggg ttgctgacgg aatcccattt 780
gctggcgaag cttatcgtca gtggattcgt gacttctatc aacaaaacaa actaatcaat 840
ggtgaacttg aagttcgcgg acgcaaagta gatttaaaaa atattaaagc taatattta 900

-103 of 112-

```
aacattgctg ctagccgtga tcatattgcg atgccgcatc aagtggcagc tttaatggac 960
gctgtttcaa gtgaagataa agagtataaa ttgttgcaaa caggtcacgt atctgttgta 1020
tttggtccaa aagcagtgaa ggaaacatat ccttcaatcg gcgattggct agaaaaacgc 1080
tctaaa                                                         1086
```

<210> 11
<211> 362
<212> PRT
<213> Bacillus megaterium

<400> 11

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Met | Ala | Ile | Pro | Tyr | Val | Gln | Glu | Trp | Glu | Lys | Leu | Ile | Lys | Ser | Met |
| 1 | | | | 5 | | | | | 10 | | | | | 15 | |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Pro | Ser | Glu | Tyr | Lys | Ser | Ser | Ala | Arg | Arg | Phe | Lys | Arg | Ala | Tyr | Glu |
| | | | 20 | | | | | 25 | | | | | 30 | | |

Ile Met Thr Thr Glu Ala Glu Pro Glu Val Gly Leu Thr Pro Lys Glu
             35             40                  45

Val Ile Trp Lys Lys Asn Lys Ala Lys Leu Tyr Arg Tyr Thr Pro Val
    50                  55                  60

Lys Asp Asn Leu His Lys Thr Pro Ile Leu Leu Val Tyr Ala Leu Ile
65                  70                  75                  80

Asn Lys Pro Tyr Ile Leu Asp Leu Thr Pro Gly Asn Ser Leu Val Glu
              85                  90                  95

Tyr Leu Leu Asn Arg Gly Phe Asp Val Tyr Leu Leu Asp Trp Gly Thr
             100             105             110

Pro Gly Leu Glu Asp Ser Asn Met Lys Leu Asp Asp Tyr Ile Val Asp
         115             120             125

Tyr Ile Pro Lys Ala Ala Lys Lys Val Leu Arg Thr Ser Lys Ser Pro
    130             135             140

Asp Leu Ser Val Leu Gly Tyr Cys Met Gly Gly Thr Met Thr Ser Ile
145             150             155             160

Phe Ala Ala Leu Asn Glu Asp Leu Pro Ile Lys Asn Leu Ile Phe Met
             165             170             175

Thr Ser Pro Phe Asp Phe Ser Asp Thr Gly Leu Tyr Gly Ala Phe Leu
         180             185             190

Asp Asp Arg Tyr Phe Asn Leu Asp Lys Ala Val Asp Thr Phe Gly Asn
         195             200             205

Ile Pro Pro Glu Met Ile Asp Phe Gly Asn Lys Met Leu Lys Pro Ile
    210             215             220

Cannon Application

Thr Asn Phe Tyr Gly Pro Tyr Val Thr Leu Val Asp Arg Ser Glu Asn
225         230             235             240

Gln Arg Phe Val Glu Ser Trp Lys Leu Met Gln Lys Trp Val Ala Asp
            245             250             255

Gly Ile Pro Phe Ala Gly Glu Ala Tyr Arg Gln Trp Ile Arg Asp Phe
            260             265             270

Tyr Gln Gln Asn Lys Leu Ile Asn Gly Glu Leu Glu Val Arg Gly Arg
            275             280             285

Lys Val Asp Leu Lys Asn Ile Lys Ala Asn Ile Leu Asn Ile Ala Ala
            290             295             300

Ser Arg Asp His Ile Ala Met Pro His Gln Val Ala Ala Leu Met Asp
305             310             315             320

Ala Val Ser Ser Glu Asp Lys Glu Tyr Lys Leu Leu Gln Thr Gly His
            325             330             335

Val Ser Val Val Phe Gly Pro Lys Ala Val Lys Glu Thr Tyr Pro Ser
            340             345             350

Ile Gly Asp Trp Leu Glu Lys Arg Ser Lys
            355             360


<210> 12
<211> 39
<212> DNA
<213> Artificial Sequence

<220>
<223> Description of Artificial Sequence:Synthetic

<400> 12
aayacrgtna aataynnnac rgtnatynnn gcdatgatg                39


<210> 13
<211> 30
<212> DNA
<213> Artificial Sequence

<220>
<223> Description of Artificial Sequence:Synthetic

<400> 13
gcdatyccdt aygtncarga agghttyaaa                          30

```
<210> 14
<211> 19
<212> DNA
<213> SYNTHETIC

<400> 14
gcttcatgcg tgcggtttg                                          19


<210> 15
<211> 22
<212> DNA
<213> SYNTHETIC

<400> 15
ggaccgttcg gaaaatcagc gg                                      22


<210> 16
<211> 20
<212> DNA
<213> SYNTHETIC

<400> 16
cccctttgtc cattgttccc                                         20


<210> 17
<211> 19
<212> DNA
<213> SYNTHETIC

<400> 17
ccatgtagat tccaccctc                                          19


<210> 18
<211> 19
<212> DNA
<213> SYNTHETIC

<400> 18
ctccatctcc tttcttgtg                                          19


<210> 19
<211> 17
<212> PRT
<213> Bacillus megaterium

<400> 19
Lys Val Phe Gly Arg Xaa Glu Leu Ala Ala Ala Met Lys Arg Xaa Gly
1               5                   10                  15
```

Cannon Application

Leu

<210> 20
<211> 15
<212> PRT
<213> Bacillus megaterium

<400> 20
Asn Thr Val Lys Tyr Xaa Thr Val Ile Xaa Ala Met Xaa Xaa Gln
 1               5                  10                  15


<210> 21
<211> 11
<212> PRT
<213> Bacillus megaterium

<400> 21
Ala Ile Pro Tyr Val Gln Glu Xaa Glu Lys Leu
 1               5                  10


<210> 22
<211> 813
<212> DNA
<213> Bacillus megaterium

<400> 22
atggatgcat cactttgtt agagtatgga tgggtattgc tagtgctggt tgcattagaa 60
ggaattttgg cggcggataa tgctcttgtg atggctatta tggtcaaaca tttaccggaa 120
gaaaaacgca agaaggcatt attttacgga ttagccggtg cctttatttt tagatttggt 180
tcgttgttct tgatttcatt tttagtcgac gtatggcagc ttcaagctat aggagccatt 240
tacttattgt tcatttccat taatcatatt gtgaagcgat atgtgaaaaa agacgatcat 300
gaaaaagtga agaagcaga cgagaaaaag ggctcaggtt tctggatgac ggtttaaaa 360
gtagaaatag cagacattgc ttttgccgtt gattcaattt tggccgctgt ggctctcgcc 420
gttacgttgc caacaacaaa tcttcctcaa attggcggac tcgacggcgg acaattcttg 480
gtgatcttcg ccggaggaat tatgggatta attattatgc gttttgctgc aacttggttc 540
gtcaagctat aaatacgcg cccaggccta gaaacggcgg cttttgctat tgtaggctgg 600
gtaggagtta agttagcggt ctatacccctt gctcatccag agttaggtat tattaatgaa 660
catttccctg aatcaaaagt gtggaaaatt acgtttttgga ttgtgttact tggcatagct 720
gcttcaggct ggtttctatc taaaaataaa gaacaaactg atcttgaagg ctcagagaaa 780
gaaaaagaat cgttaaaaaa aattgaaaat caa                            813


<210> 23
<211> 271
<212> PRT
<213> Bacillus megaterium

<400> 23

Cannon Application

```
Met Asp Ala Ser Leu Leu Leu Glu Tyr Gly Trp Val Leu Leu Val Leu
1               5                   10                  15

Val Ala Leu Glu Gly Ile Leu Ala Ala Asp Asn Ala Leu Val Met Ala
                20                  25                  30

Ile Met Val Lys His Leu Pro Glu Glu Lys Arg Lys Lys Ala Leu Phe
            35                  40                  45

Tyr Gly Leu Ala Gly Ala Phe Ile Phe Arg Phe Gly Ser Leu Phe Leu
    50                  55                  60

Ile Ser Phe Leu Val Asp Val Trp Gln Leu Gln Ala Ile Gly Ala Ile
65                  70                  75                  80

Tyr Leu Leu Phe Ile Ser Ile Asn His Ile Val Lys Arg Tyr Val Lys
                85                  90                  95

Lys Asp Asp His Glu Lys Val Lys Glu Ala Asp Glu Lys Lys Gly Ser
            100                 105                 110

Gly Phe Trp Met Thr Val Leu Lys Val Glu Ile Ala Asp Ile Ala Phe
    115                 120                 125

Ala Val Asp Ser Ile Leu Ala Ala Val Ala Leu Ala Val Thr Leu Pro
    130                 135                 140

Thr Thr Asn Leu Pro Gln Ile Gly Gly Leu Asp Gly Gly Gln Phe Leu
145                 150                 155                 160

Val Ile Phe Ala Gly Gly Ile Met Gly Leu Ile Ile Met Arg Phe Ala
                165                 170                 175

Ala Thr Trp Phe Val Lys Leu Leu Asn Thr Arg Pro Gly Leu Glu Thr
            180                 185                 190

Ala Ala Phe Ala Ile Val Gly Trp Val Gly Val Lys Leu Ala Val Tyr
    195                 200                 205

Thr Leu Ala His Pro Glu Leu Gly Ile Ile Asn Glu His Phe Pro Glu
210                 215                 220

Ser Lys Val Trp Lys Ile Thr Phe Trp Ile Val Leu Leu Gly Ile Ala
225                 230                 235                 240

Ala Ser Gly Trp Phe Leu Ser Lys Asn Lys Glu Gln Thr Asp Leu Glu
            245                 250                 255

Gly Ser Glu Lys Glu Lys Glu Ser Leu Lys Lys Ile Glu Asn Gln
            260                 265                 270
```

<210> 24

Cannon Application

<211> 708
<212> DNA
<213> Bacillus megaterium

<400> 24
atgctcacaa aagttcaaac gcctccatcg cttgaaacgc ttgtactgac gattcagcaa 60
ggggataaac aattacataa tgaaatgatt caacaatata aaccgtttat tgctaaagtt 120
gtttcagctg tatgtaaacg ttatataagt gaagctgacg atgaatttag cattggtctg 180
attgcattta atgaagccat tgaaaattac acaatccaaa aaggacgatc tcttcttgca 240
tttgcggaac ttattattaa aagaagagta atcgactata ttcgaaaaga aagcgaaat 300
caaacgctgc tctataaccg aattgaaaat gaaggtttta ttcaaggtaa ggtagaaagg 360
gatatatcgc tttctaacta taaaaggcaa agtgaaactt catatattca agaggaaatg 420
acttatttt gtcaggcgct aaaattgttt aaattaactc ttgaagacat tattaacacg 480
tctcctaaac ataaggatgc aaggggaaat gcagtggaag ttgcatcttt tatcgtcaat 540
gaaaaagat taaaagataa gctgttttta aagcggcagc ttcctattcg cttgattgaa 600
aaacatgtca aagtaagccg gaaaacaatt gaaagaaacc gtaaatatat tatcgcgatg 660
gttattatat tagcggggga ctacgtgtat ttaaaagact atattatg 708


<210> 25
<211> 236
<212> PRT
<213> Bacillus megaterium

<400> 25
Met Leu Thr Lys Val Gln Thr Pro Pro Ser Leu Glu Thr Leu Val Leu
1               5                   10                  15

Thr Ile Gln Gln Gly Asp Lys Gln Leu His Asn Glu Met Ile Gln Gln
            20                  25                  30

Tyr Lys Pro Phe Ile Ala Lys Val Val Ser Ala Val Cys Lys Arg Tyr
        35                  40                  45

Ile Ser Glu Ala Asp Asp Glu Phe Ser Ile Gly Leu Ile Ala Phe Asn
    50                  55                  60

Glu Ala Ile Glu Asn Tyr Thr Ile Gln Lys Gly Arg Ser Leu Leu Ala
65                  70                  75                  80

Phe Ala Glu Leu Ile Ile Lys Arg Arg Val Ile Asp Tyr Ile Arg Lys
                85                  90                  95

Glu Lys Arg Asn Gln Thr Leu Leu Tyr Asn Arg Ile Glu Asn Glu Gly
            100                 105                 110

Phe Ile Gln Gly Lys Val Glu Arg Asp Ile Ser Leu Ser Asn Tyr Lys
        115                 120                 125

Arg Gln Ser Glu Thr Ser Tyr Ile Gln Glu Glu Met Thr Tyr Phe Cys
130                 135                 140

Gln Ala Leu Lys Leu Phe Lys Leu Thr Leu Glu Asp Ile Ile Asn Thr

Ser Pro Lys His Lys Asp Ala Arg Gly Asn Ala Val Glu Val Ala Ser
              165                 170                 175

Phe Ile Val Asn Glu Lys Glu Leu Lys Asp Lys Leu Phe Leu Lys Arg
          180                 185                 190

Gln Leu Pro Ile Arg Leu Ile Glu Lys His Val Lys Val Ser Arg Lys
          195                 200                 205

Thr Ile Glu Arg Asn Arg Lys Tyr Ile Ile Ala Met Val Ile Ile Leu
          210                 215                 220

Ala Gly Asp Tyr Val Tyr Leu Lys Asp Tyr Ile Met
225                 230                 235


<210> 26
<211> 957
<212> DNA
<213> Bacillus megaterium

<400> 26
atgccacaac catggaaacg acgagtaagg cagatgtctt cagctcaaat tattgttaca  60
ttttacatag tggctgttac gcttgggttt ctattactta gtattccaga agctttaagg  120
ccaggagcaa agttagcatt tattgatcgc ttatttattg ccgttagtgc ggtaagtgta  180
acagggctga cacctgtctc gactccagat acatttagta caacgggcta ttttttactc  240
gtttttattt ttcaaatcgg tggtattggt gtaatgacac tcagtacatt tatttggatg  300
attttaggta aaaaaatcgg tctgaaggaa cgtcagctca ttatgacgga ccataatcaa  360
tcccgtttat caggattagt tgatttgatg agaaatattt tatttattat ttttgccatt  420
gaactagttg gcgccattat tttagggtta catttctcc gttattattc gagctggaca  480
gatgcgtttt tgcatggttt ctttgcttct gtcagtgcta caacaaatgc tggcttcgat  540
attacaggat cttcatttat tccgtatgcc catgattatt tcgtacaagt ggtaaccgtt  600
attttaatta cgcttggagc gattggattc cctgtattaa ttgaaatcaa gcactatttt  660
ttaacattta aagataagcg taaatttcaa ttttcgctat ttacgaagct aacgactatt  720
atgtttttc tgctgttagg agggggaaca atcttgattc ttgtgctaga gcattcagga  780
tttctagcag ataagtcttg ggatgaatcg ttttttatg cgttttcca atccgctgcc  840
acaaggagcg gaggagtggc gaccatgaat attaatgagt tttcacttcc tacgttaatt  900
atgatgagcg cgatgatgtt tatcggtgct tcaccgagtt cagtagggg aggaatt    957


<210> 27
<211> 319
<212> PRT
<213> Bacillus megaterium

<400> 27
Met Pro Gln Pro Trp Lys Arg Arg Val Arg Gln Met Ser Ser Ala Gln
  1               5                  10                  15

Ile Ile Val Thr Phe Tyr Ile Val Ala Val Thr Leu Gly Phe Leu Leu
          20                  25                  30

Cannon Application

```
Leu Ser Ile Pro Glu Ala Leu Arg Pro Gly Ala Lys Leu Ala Phe Ile
        35                  40                  45

Asp Arg Leu Phe Ile Ala Val Ser Ala Val Ser Val Thr Gly Leu Thr
        50                  55                  60

Pro Val Ser Thr Pro Asp Thr Phe Ser Thr Thr Gly Tyr Phe Leu Leu
65                  70                  75                      80

Val Phe Ile Phe Gln Ile Gly Gly Ile Gly Val Met Thr Leu Ser Thr
                85                  90                      95

Phe Ile Trp Met Ile Leu Gly Lys Lys Ile Gly Leu Lys Glu Arg Gln
            100             105             110

Leu Ile Met Thr Asp His Asn Gln Ser Arg Leu Ser Gly Leu Val Asp
        115                 120                 125

Leu Met Arg Asn Ile Leu Phe Ile Ile Phe Ala Ile Glu Leu Val Gly
        130                 135                 140

Ala Ile Ile Leu Gly Leu His Phe Leu Arg Tyr Tyr Ser Ser Trp Thr
145                 150                 155                 160

Asp Ala Phe Leu His Gly Phe Phe Ala Ser Val Ser Ala Thr Thr Asn
                165                 170                 175

Ala Gly Phe Asp Ile Thr Gly Ser Ser Phe Ile Pro Tyr Ala His Asp
                180                 185                 190

Tyr Phe Val Gln Val Val Thr Val Ile Leu Ile Thr Leu Gly Ala Ile
        195                 200                 205

Gly Phe Pro Val Leu Ile Glu Ile Lys His Tyr Phe Leu Thr Phe Lys
        210                 215                 220

Asp Lys Arg Lys Phe Gln Phe Ser Leu Phe Thr Lys Leu Thr Thr Ile
225                 230                 235                 240

Met Phe Phe Leu Leu Leu Gly Gly Gly Thr Ile Leu Ile Leu Val Leu
                245                 250                 255

Glu His Ser Gly Phe Leu Ala Asp Lys Ser Trp Asp Glu Ser Phe Phe
                260                 265                 270

Tyr Ala Phe Phe Gln Ser Ala Ala Thr Arg Ser Gly Gly Val Ala Thr
        275                 280                 285

Met Asn Ile Asn Glu Phe Ser Leu Pro Thr Leu Ile Met Met Ser Ala
290                 295                 300

Met Met Phe Ile Gly Ala Ser Pro Ser Ser Val Gly Gly Gly Ile
```
-111 of 112-

Cannon Application

H: 365662(7%5@01!.DOC)

<210> 28
<211> 195
<212> DNA
<213> Bacillus megaterium

<400> 28
atggctagaa caaataaact attaacacca ggagtagaac aatttttaga tcaatataaa 60
tatgaaatcg ctcaagaatt tggggtaact ctaggttctg acactgctgc acgcagcaac 120
ggttcagtag gcggagaaat cacaaaacgc ttggtgcaac aagctcaagc tcacttaagc 180
ggcagcacac aaaaa                                                   195


<210> 29
<211> 65
<212> PRT
<213> Bacillus megaterium

<400> 29
Met Ala Arg Thr Asn Lys Leu Leu Thr Pro Gly Val Glu Gln Phe Leu
 1               5                  10                  15

Asp Gln Tyr Lys Tyr Glu Ile Ala Gln Glu Phe Gly Val Thr Leu Gly
            20                  25                  30

Ser Asp Thr Ala Ala Arg Ser Asn Gly Ser Val Gly Gly Glu Ile Thr
            35                  40                  45

Lys Arg Leu Val Gln Gln Ala Gln Ala His Leu Ser Gly Ser Thr Gln
        50                  55                  60

Lys
65